

## § 98.361

## 40 CFR Ch. I (7–1–12 Edition)

the following system components: Uncovered anaerobic lagoons, liquid/slurry systems with and without crust covers (including but not limited to ponds and tanks), storage pits, digesters, solid manure storage, dry lots (including feedlots), high-rise houses for poultry production (poultry without litter), poultry production with litter, deep bedding systems for cattle and swine, manure composting, and aerobic treatment.

(c) This source category does not include system components at a livestock facility that are unrelated to the stabilization and/or storage of manure such as daily spread or pasture/range/paddock systems or land application activities or any method of manure utilization that is not listed in § 98.360(b).

(d) This source category does not include manure management activities located off site from a livestock facility or off-site manure composting operations.

### § 98.361 Reporting threshold.

Livestock facilities must report GHG emissions under this subpart if the facility meets the reporting threshold as defined in 98.360(a) above, contains a manure management system as defined in 98.360(b) above, and meets the requirements of § 98.2(a)(1).

### § 98.362 GHGs to report.

(a) Livestock facilities must report annual aggregate CH<sub>4</sub> and N<sub>2</sub>O emissions for the following MMS components at the facility:

- (1) Uncovered anaerobic lagoons.
- (2) Liquid/slurry systems (with and without crust covers, and including but not limited to ponds and tanks).
- (3) Storage pits.
- (4) Digesters, including covered anaerobic lagoons.
- (5) Solid manure storage.
- (6) Dry lots, including feedlots.
- (7) High-rise houses for poultry production (poultry without litter)
- (8) Poultry production with litter.
- (9) Deep bedding systems for cattle and swine.
- (10) Manure composting.
- (11) Aerobic treatment.

(b) A livestock facility that is subject to this rule only because of emissions from manure management system components is not required to report emissions from subparts C through PP (other than subpart JJ) of this part.

(c) A livestock facility that is subject to this part because of emissions from source categories described in subparts C through PP of this part is not required to report emissions under subpart JJ of this part unless emissions from manure management systems are 25,000 metric tons CO<sub>2</sub>e per year or more.

### § 98.363 Calculating GHG emissions.

(a) For all manure management system components listed in 98.360(b) except digesters, estimate the annual CH<sub>4</sub> emissions and sum for all the components to obtain total emissions from the manure management system for all animal types using Equation JJ-1.

$$\text{CH}_4 \text{ Emissions}_{\text{MMS}} \text{ (metric tons/yr)} = \sum_{\text{animal types}} \left[ \sum_{\text{MMS}} \left[ (\text{TVS}_{\text{AT}} \times \text{VS}_{\text{MMS}} \times (1 - \text{VS}_{\text{ss}}) \times 365 \text{ days/yr} \times (\text{B}_0)_{\text{AT}} \times \text{MCF}_{\text{MMS}}) \times 0.662 \text{ kg CH}_4/\text{m}^3 \times 1 \text{ metric ton}/1000 \text{ kg} \right] \right] \quad (\text{Eq. JJ-2})$$

Where:

MMSC = Manure management systems component.

TVS<sub>AT</sub> = Total volatile solids excreted by animal type, calculated using Equation JJ-3 of this section (kg/day).

VS<sub>MMS</sub> = Fraction of the total manure for each animal type that is managed in MMS component MMSC, assumed to be equivalent to the fraction of VS in each MMS component.

VS<sub>ss</sub> = Volatile solids removal through solid separation; if solid separation occurs prior to the MMS component, use a default value from Table JJ-4 of this section; if no solid separation occurs, this value is set to 0.

(B<sub>0</sub>)<sub>AT</sub> = Maximum CH<sub>4</sub>-producing capacity for each animal type, as specified in Table JJ-2 of this section (m<sup>3</sup> CH<sub>4</sub>/kg VS).

MCF<sub>MMS</sub> = CH<sub>4</sub> conversion factor for the MMS component, as specified in Table JJ-5 of this section (decimal).

$$\text{TVS}_{\text{AT}} = \text{Population}_{\text{AT}} \times \text{TAM}_{\text{AT}} \times \text{VS}_{\text{AT}} / 1000 \quad (\text{Eq. JJ-3})$$

Where:

$\text{TVS}_{\text{AT}}$  = Daily total volatile solids excreted per animal type (kg/day).

$\text{Population}_{\text{AT}}$  = Average annual animal population contributing manure to the manure management system by animal type (head) (see description in §98.363(a)(i) and (ii) below).

$\text{TAM}_{\text{AT}}$  = Typical animal mass for each animal type, using either default values in Table JJ-2 of this section or farm-specific data (kg/head).

$\text{VS}_{\text{AT}}$  = Volatile solids excretion rate for each animal type, using default values in Table JJ-2 or JJ-3 of this section (kg VS/day/1000 kg animal mass).

(1) Average annual animal populations for static populations (e.g.,

dairy cows, breeding swine, layers) must be estimated by performing an animal inventory or review of facility records once each reporting year.

(2) Average annual animal populations for growing populations (meat animals such as beef and veal cattle, market swine, broilers, and turkeys) must be estimated each year using the average number of days each animal is kept at the facility and the number of animals produced annually, and an equation similar or equal to Equation JJ-4 below, adapted from Equation 10.1 in *2006 IPCC Guidelines for National Greenhouse Gas Inventories*, Volume 4, Chapter 10.

$$\text{Population}_{\text{AT}} = \text{Days onsite}_{\text{AT}} \times \left( \frac{\text{NAPA}_{\text{AT}}}{365} \right) \quad (\text{Eq. JJ-4})$$

Where:

$\text{Population}_{\text{AT}}$  = Average annual animal population (by animal type).

$\text{Days onsite}_{\text{AT}}$  = Average number of days the animal is kept at the facility, by animal type.

$\text{NAPA}_{\text{AT}}$  = Number of animals produced annually, by animal type.

(b) For each digester, calculate the total amount of  $\text{CH}_4$  emissions, and then sum the emissions from all digesters, as shown in Equation JJ-5 of this section.

$$\text{H}_4 \text{ Emissions}_{\text{AD}} = \sum_1^{\text{AD}} (\text{CH}_4\text{C} - \text{CH}_4\text{D} + \text{CH}_4\text{L}) \quad (\text{Eq. JJ-5})$$

Where:

$\text{CH}_4 \text{ Emissions}_{\text{AD}}$  =  $\text{CH}_4$  emissions from anaerobic digestion (metric tons/yr).

$\text{AD}$  = Number of anaerobic digesters at the manure management facility.

$\text{CH}_4\text{C}$  =  $\text{CH}_4$  flow to digester combustion device, calculated using Equation JJ-6 of this section (metric tons  $\text{CH}_4$ /yr).

$\text{CH}_4\text{D}$  =  $\text{CH}_4$  destruction at digesters, calculated using Equation JJ-11 of this section (metric tons  $\text{CH}_4$ /yr)

$\text{CH}_4\text{L}$  = Leakage at digesters calculated using Equation JJ-12 of this section (metric tons  $\text{CH}_4$ /yr).

(1) For each digester, calculate the annual  $\text{CH}_4$  flow to the combustion device ( $\text{CH}_4\text{C}$ ) using Equation JJ-6 of this section. A fully integrated system that directly reports the quantity of  $\text{CH}_4$  flow to the digester combustion device requires only summing the results of all monitoring periods for a given year to obtain  $\text{CH}_4\text{C}$ .

$$\text{CH}_4\text{C} = \left( V \times \frac{C}{100\%} \times 0.0423 \times \frac{520^\circ\text{R}}{T} \times \frac{P}{1 \text{ atm}} \times \frac{0.454 \text{ metric ton}}{1,000 \text{ pounds}} \right) \quad (\text{Eq. JJ-6})$$

Where:

$\text{CH}_4\text{C}$  =  $\text{CH}_4$  flow to digester combustion device (metric tons  $\text{CH}_4/\text{yr}$ ).

$V$  = Average annual volumetric flow rate, calculated in Equation JJ-7 of this subsection (cubic feet  $\text{CH}_4/\text{yr}$ ).

$C$  = Average annual  $\text{CH}_4$  concentration of digester gas, calculated in Equation JJ-8 of this section (% wet basis).

0.0423 = Density of  $\text{CH}_4$  lb/scf (at 520 °R or 60 °F and 1 atm).

$T$  = Average annual temperature at which flow is measured, calculated in Equation JJ-9 of this section (°R).

$P$  = Average annual pressure at which flow is measured, calculated in Equation JJ-10 of this section (atm).

(2) For each digester, calculate the average annual volumetric flow rate,  $\text{CH}_4$  concentration of digester gas, temperature, and pressure at which flow are measured using Equations JJ-7 through JJ-10 of this section.

$$V = \frac{\sum_{n=1}^{\text{OD}} \left( V_n \times \frac{1,440 \text{ minutes}}{\text{day}} \right)}{\text{OD}} \quad (\text{Eq. JJ-7})$$

Where:

$V$  = Average annual volumetric flow rate (cubic feet  $\text{CH}_4/\text{yr}$ ).

$\text{OD}$  = Operating days, number of days per year that the digester was operating (days/yr).

$V_n$  = Daily average volumetric flow rate for day  $n$ , as determined from daily monitoring as specified in § 98.364 (acfm).

$$C = \frac{\sum_{n=1}^{\text{OD}} C_n}{\text{OD}} \quad (\text{Eq. JJ-8})$$

Where:

$C$  = Average annual  $\text{CH}_4$  concentration of digester gas (% wet basis).

$\text{OD}$  = Operating days, number of days per year that the digester was operating (days/yr).

$C_n$  = Average daily  $\text{CH}_4$  concentration of digester gas for day  $n$ , as determined from daily monitoring as specified in § 98.364 (% wet basis).

$$T = \frac{\sum_{n=1}^{\text{OD}} T_n}{\text{OD}} \quad (\text{Eq. JJ-9})$$

Where:

$T$  = Average annual temperature at which flow is measured (°R).

$\text{OD}$  = Operating days, number of days per year that the digester was operating (days/yr).

$T_n$  = Temperature at which flow is measured for day  $n$  (°R).

$$P = \frac{\sum_{n=1}^{\text{OD}} P_n}{\text{OD}} \quad (\text{Eq. JJ-10})$$

Where:

$P$  = Average annual pressure at which flow is measured (atm).

$\text{OD}$  = Operating days, number of days per year that the digester was operating (days/yr).

$P_n$  = Pressure at which flow is measured for day  $n$  (atm).

(3) For each digester, calculate the  $\text{CH}_4$  destruction at the digester combustion device using Equation JJ-11 of this section.

$$\text{CH}_4\text{D} = \text{CH}_4\text{C} \times \text{DE} \times \text{OH/Hours} \quad (\text{Eq. JJ-11})$$

Where:

$\text{CH}_4\text{D}$  =  $\text{CH}_4$  destruction at digester combustion device (metric tons/yr).

$\text{CH}_4\text{C}$  = Annual quantity of  $\text{CH}_4$  flow to digester combustion device, as calculated in Equation JJ-6 of this section (metric tons  $\text{CH}_4$ ).

$\text{DE}$  =  $\text{CH}_4$  destruction efficiency from flaring or burning in engine (lesser of manufactur-

er's specified destruction efficiency and 0.99). If the gas is transported off-site for destruction, use  $\text{DE} = 1$ .

$\text{OH}$  = Number of hours combustion device is functioning in reporting year.

Hours = Hours in reporting year.

(4) For each digester, calculate the  $\text{CH}_4$  leakage using Equation JJ-12 of this section.

$$\text{CH}_4\text{L} = \text{CH}_4\text{C} \times \left( \frac{1}{\text{CE}} - 1 \right) \quad (\text{Eq. JJ-12})$$

Where:

$\text{CH}_4\text{L}$  = Leakage at digesters (metric tons/yr).

$\text{CH}_4\text{C}$  = Annual quantity of  $\text{CH}_4$  flow to digester combustion device, as calculated in Equation JJ-6 of this section (metric tons  $\text{CH}_4$ ).

$\text{CE}$  =  $\text{CH}_4$  collection efficiency of anaerobic digester, as specified in Table JJ-6 of this section (decimal).

(c) For each MMS component, estimate the annual  $\text{N}_2\text{O}$  emissions and sum for all MMS components to obtain total emissions from the manure management system for all animal types using Equation JJ-13 of this section.

$$\begin{aligned} \text{Direct } \text{N}_2\text{O Emissions (metric tons/year)} &= \sum_{\text{animal types}} \left[ \sum_{\text{MMS}} \text{N}_{\text{ex AT}} \times \text{N}_{\text{ex,MMSC}} \right. \\ &\quad \left. \times (1 - \text{N}_{\text{ss}}) \times \text{EF}_{\text{MMSC}} \times 365 \text{ days/yr} \right] \times 44 \text{ N}_2\text{O}/28 \text{ N}_2\text{O} - \text{N} \times 1 \text{ metric ton}/1000 \text{ kg} \end{aligned} \quad (\text{Eq. JJ-13})$$

Where:

$\text{N}_{\text{ex AT}}$  = Daily total nitrogen excreted per animal type, calculated using Equation JJ-14 of this section (kg N/day).

$\text{N}_{\text{ex,MMSC}}$  = Fraction of the total manure for each animal type that is managed in MMS component MMSC, assumed to be equivalent to the fraction of  $\text{N}_{\text{ex}}$  in each MMS component.

$\text{N}_{\text{ss}}$  = Nitrogen removal through solid separation; if solid separation occurs prior to the MMS component, use a default value from Table JJ-4 of this section; if no solid separation occurs, this value is set to 0.

$\text{EF}_{\text{MMSC}}$  = Emission factor for MMS component, as specified in Table JJ-7 of this section (kg  $\text{N}_2\text{O-N/kg N}$ ).

$$\text{N}_{\text{ex AT}} = \text{Population}_{\text{AT}} \times \text{TAM}_{\text{AT}} \times \text{N}_{\text{AT}}/1000 \quad (\text{Eq. JJ-14})$$

Where:

$\text{N}_{\text{ex AT}}$  = Total nitrogen excreted per animal type (kg/day).

$\text{Population}_{\text{AT}}$  = Average annual animal population contributing manure to the manure

management system by animal type (head) (see description in § 98.363(a)(i) and (ii)).

$\text{TAM}_{\text{AT}}$  = Typical animal mass by animal type, using either default values in Table JJ-2 of this section or farm-specific data (kg/head).

## § 98.364

## 40 CFR Ch. I (7–1–12 Edition)

$N_{AT}$  = Nitrogen excretion rate by animal type, using default values in Tables JJ-2 or JJ-3 of this section (kg N/day/1000 kg animal mass).

(d) Estimate the annual total facility emissions using Equation JJ-15 of this section.

$$\text{Total Emissions (metric tons CO}_2\text{e/yr)} = [(\text{CH}_4 \text{ emissions}_{\text{MMS}} + \text{CH}_4 \text{ emissions}_{\text{AD}}) \times 21] + [\text{Direct N}_2\text{O emissions} \times 310] \quad (\text{Eq. JJ-15})$$

Where:

$\text{CH}_4 \text{ emissions}_{\text{MMS}}$  = From Equation JJ-2 of this section.

$\text{CH}_4 \text{ emissions}_{\text{AD}}$  = From Equation JJ-5 of this section.

21 = Global Warming Potential of  $\text{CH}_4$ .

Direct  $\text{N}_2\text{O}$  emissions = From Equation JJ-13 of this section.

310 = Global Warming Potential of  $\text{N}_2\text{O}$ .

### § 98.364 Monitoring and QA/QC requirements.

(a) Perform an annual animal inventory or review of facility records (for static populations) or population calculation (for growing populations) to determine the average annual animal population for each animal type (see description in § 98.363(a)(1) and (2)).

(b) Perform an analysis on your operation to determine the fraction of total manure by weight for each animal type that is managed in each on-site manure management system component. If your system changes from previous reporting periods, you must reevaluate the fraction of total manure managed in each system component.

(c) The  $\text{CH}_4$  concentration of gas from digesters must be determined using ASTM D1946-90 (Reapproved 2006) Standard Practice for Analysis of Reformed Gas by Gas Chromatography (incorporated by reference *see* § 98.7). All gas composition monitors shall be calibrated prior to the first reporting year for biogas methane and carbon dioxide content using ASTM D1946-90 (Reapproved 2006) Standard Practice for Analysis of Reformed Gas by Gas Chromatography (incorporated by reference *see* § 98.7) and recalibrated either annually or at the minimum frequency specified by the manufacturer, whichever is more frequent, or whenever the error in the midrange calibration check exceeds  $\pm 10$  percent. All monitors shall be maintained as specified by the manufacturer.

(d) All temperature and pressure monitors must be calibrated using the

procedures and frequencies specified by the manufacturer. All equipment (temperature and pressure monitors) shall be maintained as specified by the manufacturer.

(e) For digesters with gas collection systems, install, operate, maintain, and calibrate a gas flow meter capable of measuring the volumetric flow rate to provide data for the GHG emissions calculations, using the applicable methods specified in paragraphs (e)(1) through (e)(6) of this section or as specified by the manufacturer.

(1) ASME MFC-3M-2004 Measurement of Fluid Flow in Pipes Using Orifice, Nozzle, and Venturi (incorporated by reference, *see* § 98.7).

(2) ASME MFC-4M-1986 (Reaffirmed 1997) Measurement of Gas Flow by Turbine Meters (incorporated by reference, *see* § 98.7).

(3) ASME MFC-6M-1998 Measurement of Fluid Flow in Pipes Using Vortex Flowmeters (incorporated by reference, *see* § 98.7).

(4) ASME MFC-7M-1987 (Reaffirmed 1992) Measurement of Gas Flow by Means of Critical Flow Venturi Nozzles (incorporated by reference, *see* § 98.7).

(5) ASME MFC-14M-2003 Measurement of Fluid Flow Using Small Bore Precision Orifice Meters (incorporated by reference, *see* § 98.7).

(6) ASME MFC-18M-2001 Measurement of Fluid Flow using Variable Area Meters (incorporated by reference, *see* § 98.7).

(f) If applicable, the owner or operator shall document the procedures used to ensure the accuracy of gas flow rate, gas composition, temperature, and pressure measurements. These procedures include, but are not limited to, calibration of fuel flow meters and other measurement devices. The estimated accuracy of measurements made with these devices shall also be recorded, and the technical basis for these estimates shall be provided.